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Why do firms adopt CEO stock options? Evidence from the United States ^{*}

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Abstract

This paper examines the determinants of stock option introduction as a part of CEO compensation in listed US firms during the 1994-2004 period. The results are consistent with agency costs and recruiting considerations, suggesting that firms do not adjust CEO compensation in order to address the ‘investment horizon’ problem. The findings also suggest that CEO stock option adoption is not necessarily influenced by the same factors that have been found in the literature to affect the level of CEO stock-option compensation and the adoption of broad-based stock-option incentives. Overall, the findings provide evidence for several theoretical predictions, thus adding to our understanding of managerial incentives.

JEL Classification: J33, M12, M52

Keywords: Stock options, CEO compensation

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1. Introduction

Since the late 1980s, listed firms in the United States have experienced an explosion in the use of employee stock options, primarily at the executive echelon but also at the firm-wide level. It is a topic that has garnered widespread media attention and has spurred an interesting array of academic research. In particular, economic literature provides several possible reasons behind a firm's decision to adopt stock options as a part of employee compensation. First, stock options alleviate the agency problem and align managers' interests with those of shareholders (Haugen and Senbet 1981). Stock options have a non-negative asymmetric payoff that produces monetary gains only after the share price exceeds the exercise price. This convex payoff function provides an incentive to managers to become less risk-averse in their project and strategy selection, thus improving investment and financial decisions (DeFusco et al. 1990, Guay 1999).¹ Second, compared to straight salary, stock options operate as an attracting, sorting and retaining mechanism since firms awarding stock options can attract specific types of employees, especially those with less risk-aversion and a higher willingness to exert effort (Oyer and Schaefer 2005, Oyer 2004). In addition, these employees would have an incentive to stay in the firm and hold on to their stock options rather than lose them by exiting the firm. Third, stock options can provide a solution in employee compensation for firms facing financial constraints (such as liquidity constraints, tax costs and financial reporting costs) since they do not influence cash flows (Core and Guay 2001).²

¹ This traditional view has recently been challenged by Ross (2004), who shows that an agent's risk-taking tendency is influenced not only by the convexity effect of the fee schedule but also by its translation and magnification effects. The latter two effects, which can take any sign, describe the impact of the fee schedule due to translating the domain of the utility function and magnifying (or contracting) any gamble at the margin. As a result, options may be an ineffective way to make managers less risk averse. Interestingly, without making any assumptions about the agent's utility function, Braidó and Ferreira (2006) show that stock options can indeed induce managerial risk taking as long as the projects' distributions are at least partially known.

² A fourth reason could be tax advantages, but this depends both on the type of stock option scheme and the country-specific tax regulation.

It is surprising that although there is ample empirical evidence on the determinants of the level of CEO stock options (e.g. Core and Guay 1999, Yermack 1995), there has been no empirical investigation on what actually prompts firms to adopt stock options for the purposes of CEO compensation. There are some studies that focus on the introduction of broad-based stock option plans for employee compensation (e.g. employee stock option plans, ESOs), which however cannot be used to infer conclusions for the case of CEOs.

Unlike the straightforward agency theoretic rationale for CEO stock option adoption, the introduction of broad-based stock option plans is often intended to reduce unions' bargaining power (Cramton et al. 2005), advance organizational cohesion (Pendleton 2006), and encourage the accumulation of firm-specific human capital (Blair et al. 2000). Moreover, the incentive power of broad-based stock option plans is adversely affected by free rider problems, especially in larger firms, and group norms (Lazear 2004, Oyer 2004). Furthermore, the incentive effects of firm-wide use of stock options are doubtful since the risk premia stemming from firms' option-based compensation are far larger than the cost to (lower- and middle-level) employees of the resulting increases in effort (Oyer and Schaefer 2005 and 2006). In this way, it is more likely that broad-based employee stock option plans are introduced for sorting and retention purposes in firms with high recruiting and retaining costs as well as in firms that find it difficult to cut nominal salaries and hence prefer to offset wage cuts with option packages (Ittner et al. 2003, Oyer and Schaefer 2005).³

Moreover, the determinants of the decision to adopt CEO stock options do not need to be the same as the determinants of the level of CEO stock-option compensation. Particularly in the US, the portion of large listed firms using CEO stock options increased gradually from the early 1980s, in contrast to the level of CEO stock options awarded that increased

³ An additional factor could be that CEOs demand stock options because they are typically wealthier than lower- and middle-level employees. Using data from Swedish CEOs, Becker (2006) finds that non-firm CEO wealth is positively related to share-based incentives and explains the result with agency theory's premise that wealthier CEOs have less absolute risk aversion.

dramatically after the mid-1990s (Conyon and Murphy 2002). These diverse patterns illustrate that there could be different factors driving each trend (or, alternatively, similar factors could affect each trend in different ways).

This paper addresses the surge of interest in the topic of incentive and sorting aspects of compensation structure by examining the determinants behind the adoption of stock options for the purposes of CEO compensation in US firms during the 1994-2004 period. It is important to clarify the difference between adoption and use of CEO stock options. Figure 1 illustrates that the annual percentage of CEO stock option usage underestimates the percentage of CEOs that generally hold stock options of their firm. While the percentage of CEO stock option usage on an annual basis fluctuated between 66 percent and 77 percent during the 1994-2004 period, the percentage of CEOs with stock option awards and holdings increased steadily from 87 percent to 96 percent. Since most of the publicly listed US firms had adopted CEO stock options by the mid-1990s, it is interesting to examine whether the remaining firms are adopting CEO stock options due to economic theory predictions. This study utilizes Execucomp, which covers the period from 1992 to present and delivers data on executive compensation provided by the various SEC filings for firms in the S&P 1500 index, and other supplemental S&P indices, as a result of SEC regulation in 1992.⁴

The results in this research are consistent with agency costs and recruiting considerations, suggesting that firms do not adjust CEO compensation in order to address the ‘investment horizon’ problem. In particular, it is found that the likelihood for adopting stock options as a part of CEO compensation is significantly increased by the incidence of CEO

⁴ The S&P 1500 Index includes all the companies in the S&P 500, S&P MidCap 400, and S&P SmallCap 600 indices and represents about 90% of the US equity market’s capitalization. The lack of a similarly rich dataset during the stock option explosion in the late 1980s and early 1990s does not allow the examination of the adoption of CEO stock options during that period. For instance, two datasets utilized in the academic literature on CEO compensation in the US during the 1980s that cannot be used in the context of determinants for adoption of CEO stock options are (a) the Forbes data from compensation surveys which have limited information on stock options, and (b) the Hall-Liebman data, which provide detailed information on stock options but contain an unbalanced sample of only 478 firms that are large and possibly less representative of the population of listed firms.

turnover, while it is decreased by CEO ownership and CEO age. These findings provide novel evidence with respect to the CEO stock option introduction, and they are consistent with models of employee sorting using variable compensation. Thus, the adoption of stock options, a form of variable pay, could be a way for a firm to address both incentives and selection concerns.

The paper is organized as follows. Section 2 presents the hypotheses and describes the empirical methodology. The findings are analyzed in Section 3, while a robustness check is presented in Section 4. Finally, Section 5 offers a summary of the results and concludes.

2. Hypotheses and methodological approach

2.1. Hypotheses

I consider several causes for adoption of CEO stock options, namely CEO turnover incidence, firm liquidity problems, the need to lengthen the horizon of CEO incentives, and agency costs.

First, the incidence of CEO turnover is expected to increase significantly the likelihood to adopt stock options in the CEO compensation package as a result of firms' effort to attract managerial talent, especially in the tight labor markets of the booming 1990s. Principal-agent theory argues that in cases of turnover and in the absence of verifiability of agent's ability at the CEO position, the firm will prefer offering a contract related to some measure of firm performance (Harris and Holmstrom 1982, Haugen and Senbet 1981, Holmstrom 1979).⁵ In this way, instances of CEO turnover present a unique opportunity for the firm to design a new contract for the incoming CEO, thus addressing both ex-ante sorting and ex-post incentives.

⁵ Notably, the lack of knowledge about the agent's ability as CEO is prevalent for both outsider and insider succession.

Another reason that is expected to contribute to the adoption of CEO stock options is the presence of liquidity constraints in firms since stock options do not require a cash outlay. Firms with liquidity problems would try to compensate their CEO by adopting stock options in order to compete effectively in the labor market for CEOs.

A further determinant of CEO stock option introduction could be to alleviate the ‘horizon problem’ of other compensation components. Based on the short-term focus of fixed and accounting-based CEO compensation and emphasizing the role of age in incentive contracts (i.e., when agents have expected tenures less than the investment’s life), the ‘horizon problem’ hypothesis suggests that CEOs nearing retirement will choose safer and less R&D intensive projects in order to enhance accounting returns rather than choosing projects that would enhance firm’s efficiency in the long run (Dechow and Sloan 1991).⁶ In order to counteract this problem, firms should provide stock options to older CEOs.⁷ This compensation mechanism would alter the short-term focus of CEOs who are near retirement and promote investment selections that favor long-term shareholder interests. As a result of the ‘horizon problem’ in CEO incentives, CEO age is expected to be positively related with the adoption of CEO stock options.

Agency considerations are also expected to affect the introduction of CEO stock options since agency costs are mitigated when the CEO owns a substantial stake in the firm. At the same time, from a portfolio theory point of view, a CEO who already owns a substantial stake

⁶ Besides the financial and labor economics literature, industrial organization literature also discusses the problem of ‘investment horizon’, particularly in the context of firm investments in regulated industries. For instance, Lewis and Sappington (1991) suggest the presence of a horizon problem when those who select investments are not the primary beneficiaries of these investments (i.e., agents with expected tenures less than the investment’s life), and they offer as examples state regulators who decide firm investments. As a result of the ‘myopic’ regulators not selecting projects with superior, but long-term performance, firms do not benefit from efficient investments.

⁷ Also, from a personnel economics viewpoint, a not-so-obvious argument on the positive relation between CEO age and adoption of CEO stock options is that stock options could operate as a mandatory retirement factor. In particular, if the ratio of stock option compensation to total compensation is high and increases with age, then older CEOs would prefer to retire rather than work for a form of compensation for which there is a substantial possibility not to enjoy.

in her firm would become further undiversified by accepting stock option grants.⁸ This, in turn, could potentially compromise the risk-inducing properties of stock options, as the theoretical literature has recently shown for risk-averse CEOs who cannot hedge their options (Carpenter 2000, Lewellen 2006, Ross 2004).⁹

2.2. Sample and empirical methodology

For the estimations of the determinants of stock option adoption as a part of CEO compensation, I obtain data on executive compensation and firm characteristics from the *Execucomp* and *Compustat* databases. Data on monthly stock returns were obtained from the Center for Research on Security Prices (CRSP) files. Concerning the variable on CEOs' age (which is largely incomplete in *Execucomp*), comprehensive information was manually collected on executive biographies from firms' annual reports, Hoovers Online, and the Standard and Poor's Register of Corporations, Directors, and Executives.

The initial starting pool began with 20,115 firm-year observations for CEO compensation included in *Execucomp* for the 1992-2004 period.¹⁰ I create an indicator variable for firms that adopt stock options as a form of CEO compensation.¹¹ This binary dependent variable ($ADOPT_{it} = 0/1$) indicates whether a firm that did not give stock options to the CEO at year $t - 2$ and $t - 1$ does so at year t , where t is an integer between 1994 and 2004, inclusive. In other words, adopting firms were those observed as (*No*, *No*, *Yes*) in time

⁸ Besides company stock, a CEO is also undiversified in terms of human capital. As a result, the CEO may select less risky projects that would not be optimal for well-diversified outside investors (Fama 1980, Hall and Murphy 2002).

⁹ For instance, Lewellen shows that for the median CEO portfolio, the magnification effect dominates the convexity effect, thus decreasing the CEO's preference for volatility. Besides CEO ownership, a related CEO characteristic that influences a CEO's attitude towards risk is a CEO's wealth (Lewellen 2006, Ross 2004). Also, Carpenter notes that factors such as large asset value or distant evaluation date could reduce managerial risk-taking when the manager is risk averse.

¹⁰ *Execucomp* typically contains firms in the S&P 1500 index and other supplemental S&P indices, except for years 1992 and 1993, when it includes only the S&P 500 firms and a small portion of medium- and small-capitalization firms.

¹¹ When the CEO stock option value is zero or missing, we presume that the firm is not awarding the CEO with stock options.

$(t-2, t-1, t)$ whereas non-adopting firms are those observed as (No, No, No) in time $(t-2, t-1, t)$. I use two lagged periods to avoid random temporal changes in CEO compensation design, thus ensuring that the adoption of stock options is actual.¹² Also, the two lagged periods refer to the same CEO to allow for the examination of the CEO turnover effect at time t . Moreover, in order to ensure that the firm indeed adopts stock options, the CEO should not have any pending (exercisable or unexercisable) firm stock options from the past, at years $t-2$, and $t-1$.¹³ Indeed, when comparing this adoption measure with alternative ones having more lagged periods (e.g., 3 or 4), no inconsistency is found. The use of two lags in the adoption variable is preferred since stricter measurement options, in terms of additional lags, lead to a smaller sample.

There are 157 observations of firms that changed their CEO compensation design to include stock options. In contrast, there are 752 observations of firms that consistently did not award stock options to their CEOs from year $t-2$ to year t , thus creating a total sample of 909 observations for the estimation of the determinants of adoption of CEO stock options. Figure 2 shows the number of firms, by year, that are found to adopt CEO stock options using the aforementioned methodology.

The econometric specification for the logit estimation examining the likelihood of the introduction of CEO stock options is as follows:

$$\Pr(ADOPT = 1)_{it} = F(\alpha_0 + \beta \cdot x_{it} + \gamma \cdot z_{i,t-1} + \delta \cdot d_{it} + \varepsilon_{it}), \quad [1]$$

where α_0 indicates the intercept term, x_{it} is a vector of variables concerning CEO characteristics, and turnover, $z_{i,t-1}$ is a vector of lagged variables regarding firm

¹² The estimation results are robust to stricter measurements of the binary $ADOPT_{it}$ variable (e.g. to indicate whether a firm that did not give stock options to the CEO at years $t-3$, $t-2$ and $t-1$ does so at year t). However, stricter measurement options are not selected because they lead to smaller sample.

¹³ In other words, Execucomp items $SOPTEXER$, $SOPTEXSH$, $UEXNUMEX$, $UEXNUMUN$, $INMONEX$ and $INMONUN$ must be zero at the same time that BLK_VALUE (and $SOPTVAL/SOPTGRNT$) is zero. The rationale behind this constraint is that maybe the CEO had received stock options much earlier in the past, possibly when she was not even the CEO.

characteristics, d_{it} are industry and year effects, and finally ε_{it} specifies the error term. The firm variables are lagged by one period with the aim of capturing firm characteristics prior to a possible CEO turnover. $F(\cdot)$ represents the logistic cumulative distribution function used in logit analysis. In order to take into account the presence of repeated firm observations, standard errors are estimated with firm-clustering, thus allowing observations not to be independent within cluster.

The likelihood of the dependent indicator variable (*ADOPT*) is examined using a multitude of explanatory variables concerning CEO and firm characteristics. More specifically, in order to test the hypotheses, I include CEO equity ownership, CEO age, and a dummy variable indicating whether the firm has experienced a CEO turnover at year t . Also, following Yermack (1995) and Fazzari et al. (1988), I employ a dummy variable equal to 1 if a firm pays zero dividends during the respective fiscal year, and 0 otherwise, as a proxy for firm's liquidity constraints.¹⁴ In order to account for high growth firms that did not award dividends for reasons other than liquidity constraints, I interact the dividend dummy variable with Tobin's Q.¹⁵ Also, the inclusion of Tobin's Q is well motivated since Q has been found to be related to the level of stock-option awards (Yermack 1995, Mehran 1995).

Concerning control variables, I include CEO-Chairman duality, the natural logarithm of firm sales, three-year return to shareholders and three-year share volatility. Compared to a CEO who is not the Chairman of the Board, a CEO with dual responsibilities faces more complex tasks or is of higher ability, and thus may require more variable compensation. Firm size, proxied by sales, is used in compensation design as a proxy for managerial skill requirements, job complexity, and span of control (Murphy 1999). Also, consistently poor

¹⁴ Jin (2002) provides a more recent example of the use of dividends as a proxy for liquidity constraints.

¹⁵ Tobin Q is calculated using the methodology outlined in Gompers et al. (2003). The market value of assets is divided by the book value of assets, where the market value of assets is calculated as the sum of book value of assets and the market value of common stock minus the sum of the book value of common stock and balance sheet deferred taxes.

firm performance, reflected in three-year return to shareholders, provides the grounds for alterations in executive compensation design. Firm risk, proxied by standard deviation of monthly stock returns (over three years), serves as an observed measure of uncertainty and is widely suggested by the literature to be associated to variable compensation schemes (Lazear). Since Execucomp's measures for financial performance contain dividend reinvestment, I utilize the monthly holding period total return (which includes dividends and other distributions) for the calculation of firm volatility.

Table 1 presents definitions, descriptive statistics and correlations for the aforementioned variables. Furthermore, in order to capture possible industry effects in compensation practices, I include dummies for one-digit SIC industries. I also incorporate year effects to capture possible aggregate time-trends or systematic changes associated with time that commonly influence the adoption of stock options in executive compensation design. Overall, after controlling for CEO/firm characteristics and industry/year effects, it is expected the coefficients for CEO turnover, CEO age and firm liquidity constraints to be positive and significant and the coefficient for CEO equity ownership to be negative and significant.

3. Analysis of results

Table 2 presents the results (marginal effects) from logit estimations, where the dependent variable is an indicator of whether the firm adopts CEO stock options in a given year. Reporting the marginal effects offers insight on the relative importance of each explanatory variable in predicting the probability of a firm adopting CEO stock options. There are three alternative specifications for logit (Table 2, Columns I-III). The initial specification includes only CEO turnover and industry/year effects, and it is then supplemented with firm and CEO characteristics. The Hosmer-Lemeshow goodness-of-fit

tests indicate that all specified models fit the data reasonably well.¹⁶ The results identify a number of factors behind the adoption of CEO stock options, namely the incidence of CEO turnover, CEO ownership, and CEO age.¹⁷

Consistent with principal-agent theory, the incidence of CEO turnover significantly increases the likelihood to adopt stock options in the CEO compensation package. More specifically, after controlling for CEO and firm characteristics, the result suggests that a firm experiencing CEO turnover is 30 percent more likely to adopt CEO stock options. Given the fact that sorting and screening costs increase with the significance of position in the firm, the introduction of stock options as a result of CEO turnover alleviates these costs through contractual choice. Alternatively, the significance of CEO turnover in the adoption of CEO stock options could be perceived as a signaling device for the new CEO to signal her commitment to the firm's success, as well as to demonstrate confidence in her own abilities.¹⁸

Moreover, CEO ownership has a significant negative effect on the adoption of CEO stock options. The estimation results show that an increase of one percent over the mean for CEO ownership will decrease the probability of CEO stock option adoption by 0.5 percent. This magnitude appears small due to the wide distribution of CEO ownership; thus marginal effects using standard deviation difference are more meaningful economically. When the CEO ownership changes one standard deviation ($\pm 0.5\sigma$) around its mean (i.e. from 3.3 percent to 15.5 percent), the probability of CEO stock option adoption decreases by 6

¹⁶ Also, the outcomes predicted by the models correctly classify about 86 percent of the actual outcomes.

¹⁷ Notably, the results for the hypotheses are robust in alternative estimations that are not included in this paper for brevity purposes. Such estimations are [a] running logit regression separately on firms with or without CEO turnover (in the case of the sub-sample without CEO turnover, the firm characteristics are contemporaneous instead of lagged), [b] splitting the sample into smaller and larger firms and running logit estimations separately, and [c] running logit regressions by year groups in order to tackle possible stickiness for some independent variables due to repeated firm observations in the sample.

¹⁸ The positive effect of CEO turnover is not altered by CEO ownership or age; when the interactions (Turnover \times CEO ownership) and (Turnover \times CEO age) are included in the specifications, their coefficients are insignificant. Similarly, the positive effect of turnover is not altered when an interaction is added to indicate insider succession (albeit with reduced sample size due to missing observation on executive tenure in the firm), thus illustrating that stock-option compensation was less widespread to executives other than the CEO, a point also raised in Yermack.

percent, other things being equal. These findings verify the hypothesis that the incentives of CEOs with high firm ownership are already adequately aligned with those of shareholders, thus adopting stock options would provide little additional incentives and render the CEO further undiversified.

Another important finding is the rejection of the ‘horizon problem’ hypothesis according to which CEOs near retirement should receive stock option compensation. In particular, it is found that CEO age has a strong negative relation with the adoption of CEO stock option compensation. The marginal effect for CEO age illustrates that an increase in age of one year will decrease the probability of CEO stock option adoption by 0.4 percent. From an economic significance point of view, the negative coefficient is higher when one employs indicator variables, rather than a continuous measure, for CEO age. For instance, the marginal effect of a dummy variable indicating whether the CEO is over 60 years old (thus nears retirement age) is -7.5 percent.¹⁹ One explanation for the negative age effect could be the long-term character of stock options that reduce the likelihood of exercising these options for CEOs who are near retirement. In the same way, given that stock options could serve as a retention mechanism, firms’ retention concerns are lesser for CEOs nearing retirement compared to younger CEOs who are more likely to get an offer from another firm. Another explanation could be Eaton and Rosen’s (1983) suggestion that risk aversion may increase with age, thus influencing the individual’s preferences for risky compensation such as stock options.²⁰ A fourth explanation could be that markets are well aware of the quality of CEOs near retirement. This point is related to Gibbons and Murphy’s (1992) theory on career concerns, which predicts that the variance in the estimate of the CEO’s ability declines over

¹⁹ When the continuous variable on CEO age is replaced by a dummy variable indicating whether the CEO is near retirement (i.e. the CEO is over 57 years old or, alternatively, over 58, 59, 60, 61, 62, 63 or 64 years old), the marginal effect is negative and significant. Moreover, the negative marginal effect of the age dummy is gradually amplified from -5.8 percent for the ‘CEO is over 57 years old’ dummy to -9.7 percent for the ‘CEO is over 64 years old’ dummy, while consistently remaining highly significant.

²⁰ Empirical evidence on the relation between age and risk aversion shows that being age 65 or older dramatically increases one’s risk aversion (Riley and Chow 1992, Halek and Eisenhauer 2001).

time. As a result, the compensation package of older CEOs would be dominated by fixed and/or accounting-based compensation components.

Moreover, the estimate for the dividend dummy is insignificant, suggesting no association between firm liquidity constraints and the likelihood of adoption of CEO stock options. The relationship between dividend dummy and stock option adoption remains insignificant when the dummy variable for dividend yield is replaced with a continuous variable for dividend yield.²¹ The validity of this finding is strengthened by the fact that in the absence of stock options, CEOs do not have the incentive to reduce dividends in order to increase the value of their option awards.

There are also some interesting findings from the control variables. Firm size does not play a significant role in the adoption of CEO stock options, thus refuting the notion that CEO stock options are mostly adopted in larger firms due to greater monitoring problems. This finding is robust to alternative proxies for firm size, such as firm assets, market value, and number of employees. Regarding firm performance, there is no evidence that three-year financial performance is positively related to the likelihood to adopt CEO stock options. Similarly, alternative measures of firm performance (e.g. return on equity, sales growth) yield insignificant coefficients. The fact that firm performance does not significantly affect the likelihood of CEO stock option introduction could be partly attributed to the soaring bull markets in the United States throughout the 1990s that blurred the distinction of firms with poor performance. In this way, poor performance was not identified easily as affecting the likelihood of adopting CEO stock options as a remedy for poor decision making by successfully aligning CEO incentives to firm value. Besides financial performance, another

²¹ Results available upon request.

factor that is related to the level of stock options but not the adoption is growth opportunities, proxied by Tobin's Q, which is found to be significant in the estimations.²²

Consistent with standard agency theory predictions for agents with high discretion and high output uncertainty, share price volatility significantly increases the probability of adopting CEO stock options. Firms with volatile returns need to utilize incentive compensation with non-linear payoffs, such as stock-options, in order to protect the risk-averse CEO from downside risk while increasing the incentive power of executive compensation (Prendergast 2002). Moreover, interesting findings come from the Utilities dummy (i.e. firms with SIC 49) in Table 2, Column III. In the fairly regulated US utilities sector, firms are found to have a significantly lower likelihood to adopt CEO stock options. This is consistent with Jensen and Murphy's (1990) argument that political and regulatory pressures impede the efficient design of CEO compensation and with previous evidence on the negative effect of utility firms on the level of CEO stock option compensation (Yermack 1995, Bryan et al. 2000). From another viewpoint, utilities firms are found to trail behind in the adoption of CEO stock options compared to firms in other industries because they operate in a rather certain environment characterized by little R&D investment and local monopoly markets. Since utility firms do not need to increase efficiency under high levels of uncertainty, the structure of their CEOs' incentives design differs from other industries (Demsetz and Lehn 1985).

The findings on the adoption of CEO stock options contrast with the results from previous studies on the determinants of the level of CEO stock option awards. For instance, regarding CEO ownership, several studies have found no significant relation with the level of CEO stock options (Lewellen et al. 1987, Matsunaga 1995, Yermack 1995, Kole 1997). Also, concerning CEO age and the level of CEO options, no significant relation has been found by

²² Smith and Watts (1992) and Gaver and Gaver (1993) find a positive relation between equity compensation and growth opportunities, whereas Yermack finds a negative relation.

Eaton and Rosen (1983) and Yermack (1995), while Lewellen et al. report a positive relation. These contrasting results confirm that the adoption and the level of CEO stock options are not necessarily influenced by the same factors.

The paper's findings also provide a contrast with the literature's determinants for the adoption (and level) of broad-based employee stock option awards. Concerning firm size, previous studies on the introduction of broad-based employee stock options have uniformly found a positive relation with firm size (Core and Guay) and financing constraints (Smith and Watts). Nevertheless, in this study no such relations are found, thus illustrating that firm size was not a factor for listed US firms during the 1994-2004 period when they decided to adopt CEO stock option compensation. This is reasonable because the introduction of CEO stock options does not need the economies of scale for plan administration that are crucial for a broad-based employee stock option plan. Similar rationale probably holds for the case of liquidity constraints, which are found to affect the adoption of broad-based employee stock option plans positively, but not the adoption of CEO stock options.

4. Robustness Check

In this section, I provide an important robustness check of the results obtained from logit estimation on adoption of CEO stock options by using multinomial logit estimation. In terms of empirical design, the logit estimation strategy [1] recognizes only two types of firm action in a single estimation, namely, (a) not having CEO stock options at $t - 2$ and $t - 1$, but at time t adopting CEO stock options, and (b) not having stock options throughout $t - 2$, $t - 1$ and t . In this way, I examine the determinants for the firm's decision to start awarding CEO stock options.

As a robustness check, I repeat the same specification with [1], while taking into account firms that had adopted stock options before the beginning of the sample period and

that appear to award CEO stock options either regularly or temporarily. For this purpose, using the same specification with [1], I perform a multinomial logit estimation procedure where the dependent variable contains all mutually exclusive and collectively exhaustive unordered alternatives outcomes (i.e., possible firm decisions for awarding CEO stock options in three consecutive years), which allows for complete representation of the choice process. The multinomial logit is employed as a robustness check because its estimation involves a larger sample (13,042 instead of 909 observations) and set of alternatives (4 instead of 2), thus allowing for further heterogeneity across firms.²³

Table 3 explains the four possible outcomes used in the multinomial logit estimation, while Table 4 presents the estimates of multinomial logit for the ‘Adoption’ outcome (i.e., *No*, *No*, *Yes* respectively in $t-2$, $t-1$, t).²⁴ The findings confirm that CEO turnover, ownership, and age are factors robustly influencing the adoption of CEO stock options. It is also found that utility firms have a significant lower likelihood to adopt CEO stock options than the other firms. Furthermore, the results from the multinomial logit estimation corroborate the finding that CEO duality, firm liquidity, firm size and financial performance are factors not influencing a firm’s decision to start awarding its CEO with stock options. Finally, in all logit and multinomial logit estimations, the year dummies are not significant,

²³ The remaining Execucomp observations (i.e., 20115-13042=7073 obs.) are not included for two reasons. First, we need two lags for each company to construct the dependent variables. Since Execucomp starts from 1992, then by default the sample starts from 1994. Also the unbalanced nature of Execucomp sample means that some firms are not included because they do not have enough lags. This reason accounts for 5308 observations, mostly for the years before 1995. Second, in order to estimate the effect of CEO turnover on CEO stock option adoption, we require the same CEO to be in office for $t-1$ and $t-2$ (so at t , either she remains or the firm experiences CEO turnover). The final sample thus excludes 1765 observations from firms that either had three different CEOs within three years (e.g. using an interim CEO while searching for the future CEO), or the turnover happened at $t-1$ and cannot be directly connected with the incidence of CEO adoption at time t .

²⁴ For the multinomial logit estimation, the coefficient estimates are presented in lieu of the marginal effects since the latter cannot be clearly interpreted (Greene 2000).

reflecting the lack of any systemic changes, such as regulatory intervention, in the decision to award CEO stock options.²⁵

5. Conclusion

The role of designing optimal compensation contracts is to align the otherwise unobservable managerial actions with shareholders' desires. This paper examines the effect of CEO and firm characteristics on the introduction of CEO stock options in a large number of firms in the United States during the 1994-2004 period. The primary research hypothesis is that the adoption of a CEO stock option plan occurs as a result of agency costs, search for managerial talent, liquidity constraints, and investment horizon considerations. The results provide evidence for several economic theory predictions. In particular, it is found that the likelihood for adopting stock options as a part of CEO compensation is significantly decreased by CEO ownership and CEO age, while it is increased by the incidence of CEO turnover. Overall, these results provide a novel insight into the executive compensation literature by demonstrating the extent to which firm and CEO characteristics are related to firms' decision to adopt stock options for the purposes of CEO compensation.

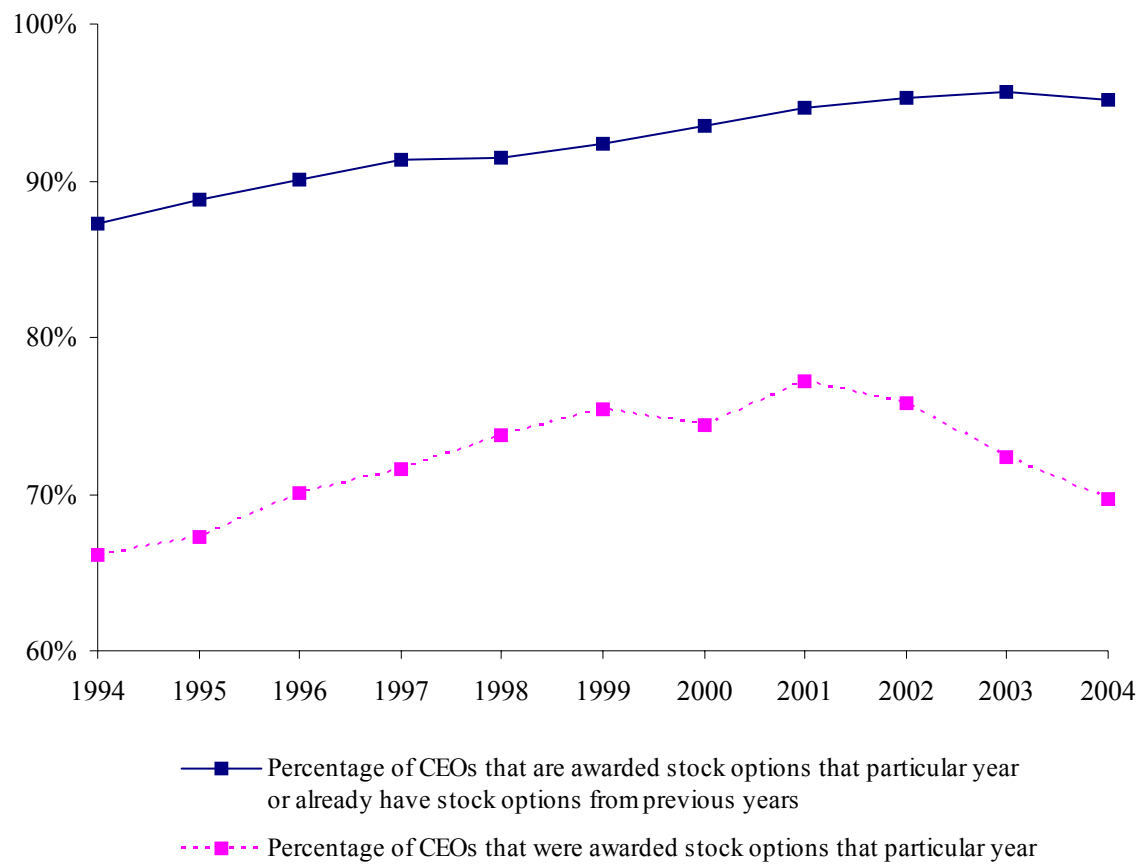
²⁵ Indeed, during the sample period (1994-2004), the accounting for stock options was generally based on rule 25/1972 by the Accounting Principles Board (the predecessor to the Financial Accounting Standards Board). FASB Statement 123 in 1995 recommended some alterations in the way firms expense the cost of stock options, but its voluntary character resulted in very few companies implementing this guideline.

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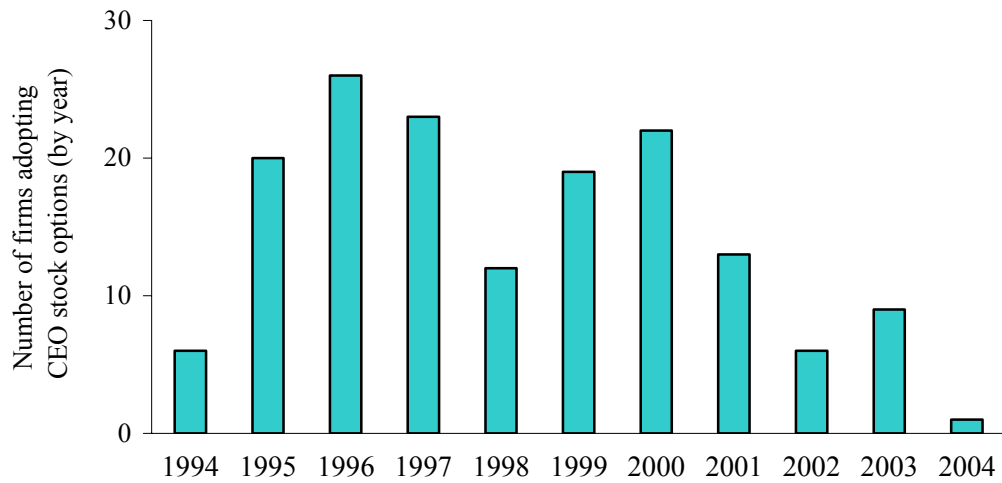
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Figure 1: Descriptive statistics for use of CEO stock options in S&P 1500 firms

Source: Execucomp

Figure 2: Adoption of stock options in CEO compensation in S&P 1500 firms

Note: The source for this figure is the Execucomp database using the methodology outlined in Section 2.2. Execucomp typically includes firms in the S&P 1500 index (and other supplemental S&P indices) except for years 1992 and 1993, when it includes only the S&P 500 firms and a small portion of medium- and small-capitalization firms. As a result, the number of firms that adopt CEO stock options in 1994 and 1995 may be lower than the respective number for the S&P 1500 in those years.

Table 1: Descriptive statistics of variables for analysis

Variables	Definition	Mean	St.Dev.	1	2	3	4	5	6	7	8	9
1 CEO Turnover	Dummy variable taking value 1, if there was a change of persons in CEO position, and 0 otherwise.	0.12	0.32		-0.26*	-0.25*	-0.34*	-0.07*	-0.02	-0.06	-0.04	0.01
2 CEO Ownership	CEO's stock ownership of the firm, as a percentage of the total outstanding shares – <i>in percentage form</i>	9.44	12.22	-0.21*		0.13*	0.11*	-0.24*	0.08*	0.27*	0.42*	0.43*
3 CEO Age	CEO's age (in years) at the end of the fiscal year	58.01	9.83	-0.22*	0.07*		0.28*	0.00	0.00	-0.16*	-0.05	-0.05
4 CEO is Chairman	Dummy variable taking value 1, if the CEO is also the firm's Chairman of the board of directors, and 0 otherwise.	0.70	0.45	-0.34*	0.16*	0.25*		0.01	0.00	0.00	0.03	-0.06
5 Firm sales	Firm size, in terms of firm's annual sales – <i>in \$billion</i>	2.33	4.51	0.04	-0.00	0.02	0.02		0.07*	-0.17*	-0.15*	-0.31*
6 Return to shareholder (3 yrs)	Three year total return to shareholders, including the monthly reinvestment of dividends - <i>in percentage form</i>	12.18	22.10	-0.04	0.06	-0.02	0.02	0.05		0.02	0.41*	-0.01
7 Dividend dummy	Dummy variable taking value 1 if a firm pays zero dividends during the respective fiscal year, and 0 otherwise.	0.28	0.44	-0.06	0.24*	-0.18*	0.00	0.00	0.04		0.29*	0.55*
8 Tobin's Q	(BV of Assets + MV of Common Stock - BV of Common Stock - Deferred taxes) / BV of Assets	2.19	1.96	-0.03	0.18*	-0.14*	0.00	0.02	0.55*	0.26*		0.35*
9 Firm risk	Standard deviation of monthly firm returns over three years	9.63	5.49	0.02	0.19*	-0.16*	-0.05	-0.14*	-0.04	0.56*	0.26*	

Definitions and descriptive statistics for independent variables used in logit analysis for adoption of stock options in their CEO compensation design are given below. Pearson and Spearman correlation coefficients for the independent variables used in the estimations are reported below and above the diagonal, respectively. The asterisk (*) denotes two-tailed significance levels equal or less than 0.05 ($\alpha \leq 0.05$). The pooled sample contains a panel of 909 observations in the 1994-2004 period. Data was obtained from S&P Execucomp, S&P Compustat, CRSP, Hoovers Online, and S&P Register of Corporations, Directors, and Executives. The variable for firm sales is adjusted for inflation.

Table 2: Determinants of the adoption of CEO stock option awards

<i>Independent Variables</i>	<i>Dependent Variable: Pr(ADOPT=1)</i>		
	Logit estimation	Logit estimation	Logit estimation
	I	II	III
CEO Turnover	0.427*** (7.37)	0.302*** (4.28)	0.291*** (4.12)
CEO Ownership	—	-0.0049*** (-3.52)	-0.0057*** (-4.00)
CEO Age	—	-0.0046*** (-3.89)	-0.0048*** (-3.99)
CEO is Chairman	—	-0.005 (-0.24)	-0.006 (-0.27)
\ln Firm sales $_{t-1}$	—	0.0004 (0.05)	0.0003 (0.04)
Return to shareholders (3yr) $_{t-1}$	—	0.0004 (0.74)	0.0004 (0.77)
Dividend dummy $_{t-1}$	—	0.042 (0.87)	0.036 (0.79)
(Dividend dummy \times Tobin Q) $_{t-1}$	—	-0.008 (-0.68)	-0.008 (-0.71)
Tobin's Q $_{t-1}$	—	-0.004 (-0.79)	-0.006 (-1.04)
Firm risk $_{t-1}$	—	0.007*** (3.18)	0.007*** (3.02)
Utilities	—	—	-0.104*** (-3.97)
Industry effects (1-digit SIC)	Yes	Yes	Yes
Year effects	Yes	Yes	Yes
Observations	909	843	843
Pseudo R^2	0.157	0.239	0.245
Hosmer-Lemeshow χ^2 (p-value)	(0.980)	(0.364)	(0.584)

Specifications I-III present three alternative logit specifications for the likelihood to adopt CEO stock options. Coefficients are marginal effects on the probability that a firm adopts CEO stock options. Marginal effects for binary independent variables denote the discrete change in probability for adopting CEO stock option as the binary variable changes from 0 to 1. All logits were run with a constant term. Number of observations differs between specifications due to missing observations in some variables. Standard errors are adjusted for firm-clustering and estimated using the Huber-White estimator of variance; the values of z-statistics appear in parentheses below each marginal effect. Asterisks denote significance at 1 percent (***), 5 percent (**), and 10 percent (*) levels.

Table 3: Outcomes of dependent variable for multinomial logit estimation

	Award CEO stock options at time:			Observations (%)
	$t - 2$	$t - 1$	t	
Outcome = 0 [no-use of stock options]	No	No	No	752 (5.8%)
Outcome = 1 [adoption of stock options]	No	No	Yes	157 (1.2%)
Outcome = 2 [regular use of stock options]	Yes	Yes	Yes	7262 (55.7%)
Outcome = 3 [temporary changes in use of SO]	Yes/No	Yes/No	Yes/No	4871 (37.3%)
Total				13042 (100%)

The sample employed for the multinomial logit estimation (presented in Table 4) contains 13042 firms with at least three consecutive years in Execucomp. The firms in this sample cover the period 1994-2004 and can be partitioned into four categories (0 to 3) based on the presence of CEO stock options as a part of their CEO compensation package in three consecutive years. A model employing these four categories is fully saturated since the variables are mutually exclusive and collectively exhaustive. Outcome '3' contains all temporary changes in CEO compensation changes in the use of stock options (i.e. *YYN*, *YNY*, *YNN*, *YYY*, *NYN*) as well as cases of CEOs being awarded stock options not during but prior to a three year period. Notably, the logit regressions in Table 2 (Column I) are based on the first two outcomes (i.e. 752 plus 157 equals 909 observations). Finally, time t takes values between 1994 and 2004, inclusive.

Table 4: Robustness check for determinants of the adoption of CEO stock option awards

Independent Variables	<i>Dependent Variable: Pr(OUTCOME=1)</i>		
	Multinomial logit estimation	Multinomial logit estimation	Multinomial logit estimation
	I	II	III
Constant	-1.728*** (-3.50)	3.571*** (2.43)	4.140*** (2.69)
CEO Turnover	2.268*** (9.26)	1.953*** (7.11)	1.957*** (7.12)
CEO Ownership	—	-0.027*** (-2.64)	-0.031*** (-2.82)
CEO Age	—	-0.064*** (-3.77)	-0.065*** (-3.78)
CEO is Chairman	—	-0.026 (-0.11)	-0.036 (-0.15)
\ln Firm sales $_{t-1}$	—	0.032 (0.45)	0.019 (0.26)
Return to shareholders (3yr) $_{t-1}$	—	0.007* (1.69)	0.006 (1.50)
Dividend dummy $_{t-1}$	—	-0.191 (-0.57)	-0.175 (-0.51)
(Dividend dummy \times Tobin Q) $_{t-1}$	—	0.018 (0.22)	0.022 (0.29)
Tobin's Q $_{t-1}$	—	-0.175** (-2.27)	-0.168** (-2.43)
Firm risk $_{t-1}$	—	0.101*** (3.82)	0.082*** (3.19)
Utilities	—	—	-0.673 (-1.53)
Industry effects (1-digit SIC)	Yes	Yes	Yes
Year effects	Yes	Yes	Yes
Observations	13042	12121	12121
Pseudo R^2	0.032	0.099	0.105

Specifications I-III contain the results for the $\text{Pr}(\text{OUTCOME}=1)$ from a multinomial logit estimation employing all four possible outcomes regarding the inclusion of stock option in CEO compensation in three consecutive years, as presented in Table 3. The base outcome is 'no use of stock options' ($\text{OUTCOME}=0$) and the remaining outcomes pass the Hausman-McFadden test for the IIA assumption. The pseudo- R^2 counts all four possible outcomes. Number of observations differs between specifications due to missing observations in some variables. Standard errors are adjusted for firm-clustering and estimated using the Huber-White estimator of variance; the values of z -statistics appear in parentheses below each coefficient estimate. Asterisks denote significance at 1 percent (***), 5 percent (**), and 10 percent (*) levels.